CLAIMS

What is claimed is:

1. A hybrid power generation system for neutralizing contaminated air while generating power, comprising:

a shaft;

a generator, coupled to the shaft, to generate AC power;

a compressor, coupled to the shaft, to receive a supply of air having one or more contaminates, said compressor to provide a supply of compressed air;

a combustor coupled to receive the supply of compressed air and a supply of fuel, said combustor to combust the supply of fuel and to provide a unit of exhaust gas;

a turbine coupled to the shaft and coupled to receive the exhaust gas, said unit of exhaust gas to flow through the turbine to rotate the shaft;

a fuel cell module coupled to receive the unit of exhaust gas at an inlet port, and coupled to receive an additional supply of fuel, said fuel cell module to heat the unit of exhaust gas to a temperature that is greater than a temperature at the inlet port and provide the exhaust gas at a fuel cell outlet port, said fuel cell module to generate an output voltage on a voltage line; and

a power controller electrically coupled to the generator, said power controller including a power converter to convert said AC power to DC power on a DC bus for providing power to a load, said power controller to regulate the flow of the unit of exhaust gas to the fuel cell module, independent of the DC power on the DC bus.

2. The system of claim 1 further comprising a DC/DC converter to controllably couple the voltage line to DC bus under control of the power controller.

3. The system of claim 1 further comprising an additional converter coupled between the DC bus and the load, said additional converter to convert the DC power on the DC bus to an AC power having a fixed frequency.

4. The system of claim 3 wherein the load is a power grid.

5. The system of claim 1 further comprising a break resistor controllably coupled to the DC bus, to break resistor to sink power from the DC bus under control of the power controller.

6. The system of claim 3 further comprising an energy reservoir controllably coupled to the DC bus via an energy converter under control of the power controller.

7. The system of claim 6 wherein the energy reservoir is one or more of a battery, flywheel, ultracap, and supercap.

8. The system of claim 6 wherein the generator is a motor/generator and said power converter and said additional power converter are bi-directional, said power controller to direct the power converter and one of said energy converter and said additional converter to provide power to the motor/generator at startup.

9. The system of claim 2 wherein the power controller isolates the AC power from the DC bus and couples the output voltage on the voltage line to the DC bus for providing power to the load.

10. The system of claim 1 further comprising a recuperator having a high pressure side and a low pressure side, said supply of compressed air flowing through said high pressure side, and said exhaust gas flowing through the low pressure side.

11. The system of claim 10 wherein the fuel cell module is positioned between the turbine and the low pressure side of the recuperator.

12. The system of claim 10 wherein the fuel cell module is positioned at an outlet port of the low pressure side of the recuperator.

13. The system of claim 1 wherein the fuel cell module comprises one of the following modules: solid oxide fuel cell ("SOFC") module, molten carbonate fuel

cell ("MCFC") module, direct methanol fuel cell ("DMFC") module, proton exchange membrane fuel cell ("PEMFC") module, phosphoric acid fuel cell ("PAFC") module, and alkaline fuel cell ("AFC") module.

14. The system of claim 1 further comprising a fuel controller for providing the supply of fuel to the combustor under control of the power controller, and an additional fuel controller to supply the additional fuel supply to the fuel cell module under control of the power controller.

15. The system of claim 1 wherein the generator can operate as a motor to drive the shaft.

16. The system of claim 1 further comprising a temperature sensor coupled to the turbine to sense a temperature, said sensor coupled to the power controller, said power controller to vary the supply of fuel to the combustor to control the temperature, said control of the temperature being independent of the DC power on the DC bus.

17. The system of claim 11 wherein the fuel cell module heats said unit of exhaust gas to a temperature of at least 500 degrees Fahrenheit.

18. The system of claim 12 wherein the fuel cell module heats said unit of exhaust gas to a temperature of at least 1500 degrees Fahrenheit.

19. The system of claim 1 wherein heat generated by the fuel cell module neutralizes at least one of the one or more contaminates.

20. A hybrid turbogenerator system for neutralizing contaminated air while generating power, comprising:

a shaft;

a generator, coupled to the shaft, to generate AC power;

a compressor, coupled to the shaft, to receive a supply of air having one or more contaminates, said compressor to provide a supply of compressed air;

a fuel cell module coupled to receive the supply of compressed air at an inlet port, and coupled to receive an additional supply of fuel, said fuel cell module to heat the supply of compressed air to a temperature that is greater than a temperature at the inlet port and provide the supply of compressed air at an outlet port, said fuel cell module to generate an output voltage on a voltage line; and

a combustor coupled to receive the supply of compressed air and a supply of fuel, said combustor to combust the supply of fuel and to provide a unit of exhaust gas;

a turbine coupled to the shaft and coupled to receive the unit of exhaust gas, said unit of exhaust gas to flow through the turbine to rotate the shaft; and

a power controller electrically coupled to the generator, said power controller including a power converter to convert said AC power to DC power on a DC bus for

providing power to a load, said power controller to regulate the flow of the unit of exhaust gas to the fuel cell module, independent of the DC power on the DC bus.

21. The system of claim 20 further comprising a DC/DC converter to controllably couple the voltage line to DC bus under control of the power controller.

22. The system of claim 20 further comprising an additional converter coupled between the DC bus and the load, said additional converter to convert the DC power on the DC bus to an AC power having a fixed frequency.

23. The system of claim 22 further comprising an energy reservoir controllably coupled to the DC bus via an energy converter under control of the power controller.

24. The system of claim 23 wherein the energy reservoir is one or more of a battery, flywheel, ultracap, and supercap.

25. The system of claim 23 wherein the generator is a motor/generator and said power converter and said additional power converter are bi-directional, said power controller to direct the power converter and one of said energy converter and said additional converter to provide power to the motor/generator at startup.

26. The system of claim 21 wherein the power controller isolates the AC power from the DC bus and couples the output voltage on the voltage line to the DC bus for providing power to the load.

27. The system of claim 20 further comprising a recuperator having a high pressure side and a low pressure side, said supply of compressed air flowing through said high pressure side, and said exhaust gas flowing through the low pressure side.

28. The system of claim 27 wherein the fuel cell module is positioned between the high pressure side of the recuperator and the combustor.

29. The system of claim 20 wherein the fuel cell module comprises one of the following modules: solid oxide fuel cell ("SOFC") module, molten carbonate fuel cell ("MCFC") module, direct methanol fuel cell ("DMFC") module, proton exchange membrane fuel cell ("PEMFC") module, phosphoric acid fuel cell ("PAFC") module, and alkaline fuel cell ("AFC") module.

30. The system of claim 20 further comprising a fuel controller for providing the supply of fuel to the combustor under control of the power controller, and an additional fuel controller to supply the additional fuel supply to the fuel cell module under control of the power controller.

31. The system of claim 20 further comprising a temperature sensor coupled to the turbine to sense a temperature, said sensor coupled to the power controller, said power controller to vary the supply of fuel to the combustor to control the temperature, said control of the temperature being independent of the DC power on the DC bus.

32. The system of claim 20 wherein the fuel cell module heats said unit of exhaust gas to a temperature of at least 1500 degrees Fahrenheit.

33. The system of claim 20 wherein heat generated by the fuel cell module neutralizes at least one of the one or more contaminates.